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Analysis of Mathematics Problem-Solving Ability of Junior High School Students in Emotional Intelligence

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Abstract

This study aims to describe the problem-solving skills that students learn from emotional intelligence. This type of research is descriptive and qualitative. The instruments used are questionnaires, tests, and interviews. The questionnaire instrument was used to measure students' emotional intelligence. The test instrument was used to measure problem-solving skills, and interviews were conducted to learn more about problem-solving skills. The subjects of this study were 5 of 15 students from class VIII who were taken as a sample and then given an ability test and analysis based on Krulik and Rudnick's problem-solving steps. Subjects with high emotional intelligence can understand the context of the problem and represent the problem with pictures. Students can link between information, use appropriate strategies or steps, and relevant answers and conclusions. The subject with medium emotional intelligence is rewriting information on the problem using mathematical models and their language. Subjects can relate information, but not all students' answers are correct. Subjects with low emotional intelligence do not make representations or use clear problem-solving strategies. Subjects cannot relate information, so they do wrong calculations and only guess the answer.

Keywords: emotional intelligence; junior high school students; mathematics problem-solving ability

I. Introduction

Mathematics is a science with regular patterns, an organized structure from elements not defined in axioms or postulates, and propositions (Maftukhah, 2018). The general purpose of learning mathematics is so that students can solve problems, which includes the skills of understanding problems, designing mathematical models, completing models, and interpreting the solutions obtained (Hasbullah & Wiratomo, 2015). From the results of the research conducted, it was found that students' mathematical problem-solving abilities were relatively low (Firdaus et al., 2019; Khoirunisa & Hartati, 2017; Qolfathiriyus et al., 2019). Students' low problem-solving ability will impact learning outcomes (Andriyani & Suniasih, 2021; Fasni et al., 2017; Kalsum et al., 2018).

Problem-solving ability is a process of using mathematical advantages to solve problems or actions in solving a problem to find a way out of difficulty (Izah, 2018). Mathematical problems can be solved through several steps (Krulik & Rudnick, 1995) describe the process that must be carried out in solving problems, namely 1) reading and thinking, 2) exploring and planning, 3) choosing a strategy, 4) finding an answer, and 5) review and discuss.

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Suryani et al. (2020) conducted the research entitled "Analysis of Students' Problem-Solving Ability Based on Initial Mathematics Ability." The results obtained in this study were that students' mathematical problem-solving abilities through the Problem-Based Learning model were getting better. Students who initially had low abilities increased to students with medium abilities, with an increase of 75%—initially classified as medium ability students increased to high ability students by 26%. It can be concluded that the ability to solve mathematical problems before implementing the PBL model is still relatively low.

The ability to solve problems depends on students' knowledge but also affects students' emotional intelligence (Daulay, 2022; Oeleu et al., 2019; Siagian et al., 2021). Generating enthusiasm or encouragement when solving problems, good emotional intelligence is always needed, especially in the field of mathematics that functions in problem-solving (Maftukhah, 2018). The emotional state is significant when individuals solve problems, emotions motivate individuals to think and take action, and the greater the individual's ability to understand emotions, the easier it is for individuals to solve the problems they face (Choirudin et al., 2021; Wahyuni et al., 2018).

Emotional intelligence is an individual's ability to control emotions, resistance to failure, motivate oneself, delay gratification, and regulate the state of the heart and soul (Mudhiah & Amin, 2020). This emotional intelligence means that individuals can control their emotions when taking action (Mudhiah & Amin, 2020). Goleman (2015) suggests that emotional intelligence is divided into five dimensions, including 1) recognizing one's own emotions, 2) controlling one's own emotions, 3) motivating oneself, 4) empathizing, and 5) building relationships with others. The existence of emotional intelligence in learning activities will stimulate students' open attitude in exchanging ideas and increase interest in challenges in finding problem-solving (Karina et al., 2014).

The problem-solving ability has a close relationship with students' emotional intelligence because students' emotional intelligence in problem-solving will affect their achievement (Elvira, 2019; Maryani et al., 2019; Ndawo, 2021). According to Jatisunda et al. (2017), more than training students in problem-solving and mathematical thinking exercises is required. Good emotional intelligence abilities must also accompany it through problem-solving processes to overcome difficulties in real life. Therefore, schools and teachers must be able to help students better control their emotions to achieve better learning outcomes (Smita et al., 2015).

Research conducted by Hayati & Toyib (2022) entitled "Student Problem-Solving Ability in Solving HOTS-Oriented Set Problems because of Emotional Intelligence." This study uses problem-solving, according to Polya. The difference with this research is using problem-solving, according to Krulik & Rudnick. Then Meilani & Diana's (2022) research entitled "Analysis of Problem-Solving Ability in Emotional Intelligence of Class XII IPA Students at Korpri Bekasi High School. The scope of emotional intelligence is only on the aspect of motivation. The difference with this study is the overall scope of the emotional intelligence questionnaire test, including self-awareness, self-regulation, motivation, empathy, and social skills.

In several previous studies related to emotional intelligence, including research conducted (Rospitasari, 2017) based on the results of statistical tests, it can be concluded that there is a positive relationship between emotional intelligence and mathematical problem-solving ability. The higher the emotional intelligence, the greater the ability to solve mathematical problems. Furthermore, (Eva & Kusrini, 2016) stated that the higher the emotional intelligence and creative thinking of students, the higher the learning outcomes they achieve.

This study chose to use Krulik and Rudnick's problem-solving steps. Student

problem-solving steps are shown in a more complex framework than just a linear one because students may be able to return to previous problem-solving steps when experiencing difficulties and have to go through the same or repeated stages while completing the problem. Krulik and Rudnick describe the steps of problem-solving in five steps, namely: 1) reading and thinking 2) exploring and planning, 3) choosing a strategy, 4) finding an answer, and 5) reviewing and discussing.

The formulation of the problem studied is the ability to solve mathematical problems regarding students' emotional intelligence. This study aimed to describe the students' mathematical problem-solving ability using the steps of (Krulik & Rudnick, 1995) in terms of students' emotional intelligence.

II. Research Method

The research type is descriptive qualitative research that describes students' problem-solving abilities in solving mathematical problems regarding emotional intelligence. The subjects of this study were five students from class VIII, divided into three groups, high, medium, and low emotional intelligence. The instruments used in this research are questionnaire instruments to measure emotional intelligence, test instruments to measure problem-solving abilities, and interviews to confirm student difficulties in solving problems. The flow of determining the sample is the first step. The researcher distributes *a google form* link containing as many as 25 questions to measure students' emotional intelligence. The emotional intelligence questionnaire uses a questionnaire developed (Lanawati, 1999), namely the Emotional Intelligence Inventory (EII), to measure students' emotional intelligence levels. The second step is calculating the total score from filling out emotional intelligence questionnaires. The level of emotional intelligence of students is obtained from the results of emotional intelligence scores concerning the category of emotional intelligence levels that have been made (Arikunto, 2016):

Table 1.
Categories of emotional intelligence level

Score Range	Category
$s \geq (\bar{x} + SD)$	High
$(\bar{x} - SD) < s < (\bar{x} + SD)$	Medium
$s \leq (\bar{x} - SD)$	Low

Information:
$\bar{x}$ =Average score
s = Student scores
SD = Standard deviation

In the third step, take five subjects to represent with the criteria of high, medium, and low emotional intelligence. Then, two description contextual problems related to flat side shape material were given to analyze the problem-solving ability. The step in analyzing it is correcting the math problem-solving test results based on the indicators of problem-solving abilities achieved. The data analysis process uses data analysis by (Miles & Huberman, 1994), namely reduction, presentation, and conclusion. Data reduction was obtained by selecting subjects with an emotional intelligence questionnaire—presentation of data, namely narrative text about the explanation of the research results that have been presented. The conclusion drawn is adjusted to the purpose of this study, which is to describe the problem-solving abilities of junior high school students based on emotional intelligence.

Table 2.
Initials of emotional intelligence subjects

Initials	Questionnaire Score	Category
SH	93	High
MD	75	Medium
GA	82	Medium
BA	35	Low
DP	42	Low

III. Results and Discussion

According to Krulik-Rudnick, this analysis focuses on students' problem-solving

abilities. It is known that the purpose of the study is to determine mathematical problem-solving ability and its relationship with students' emotional intelligence. The indicators of problem-solving, according to (Krulik & Rudnick, 1995), are 1) reading and thinking, 2) exploring and planning 3) choosing a strategy, 4) finding an answer, and 5) reviewing and discussing.

The results of the data analysis performed show that the emotional intelligence scale has an empirical mean of 107.55 with a standard deviation of 6.14. The researcher then divided the emotional intelligence data based on the empirical mean and standard deviation into three categories, namely:

Table 3.
Students' emotional intelligence level

Score Range	Category
$s \geq 113{,}6$	High
$101{,}4 < s < 113{,}6$	Medium
$s \leq 101{,}4$	Low

The analysis of problem-solving abilities with high emotional intelligence one students, medium emotional intelligence two students, and low emotional intelligence two students.

1. **Subjects with High Emotional Intelligence**
SH Subject

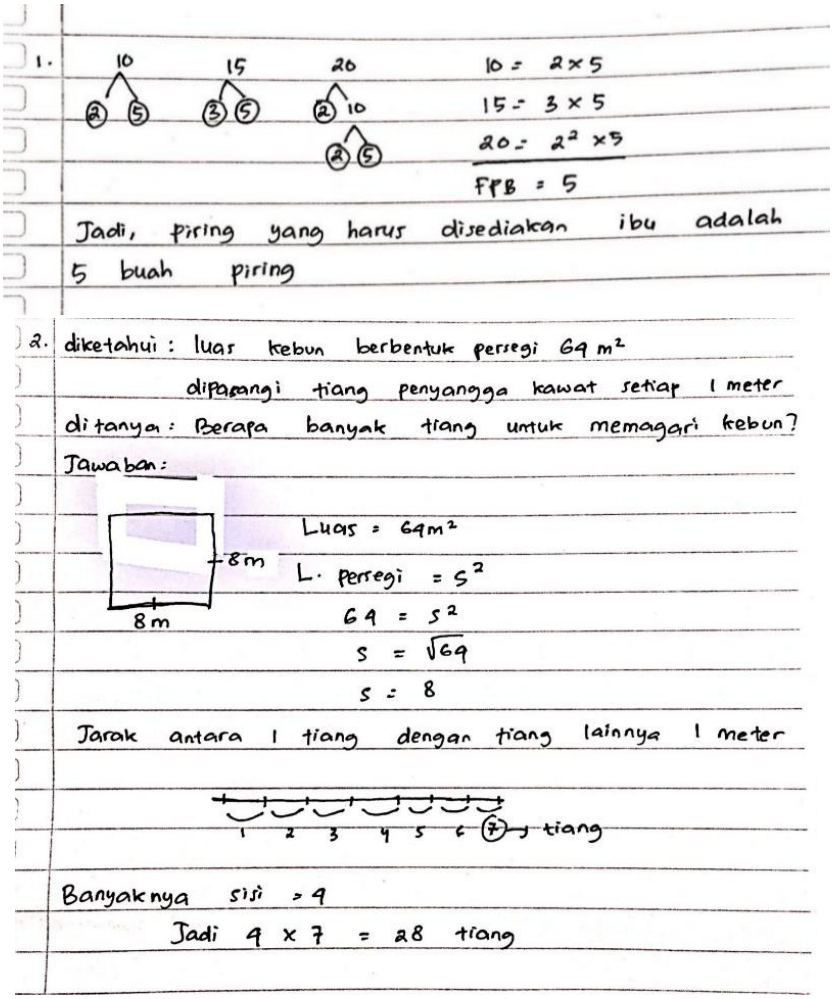

Figure 1. Result of SH work on questions number 1 and 2.

The student test analysis results are presented in Table 4.

Table 4.
Analysis results in numbers 1 and 2 for SH subjects

No	Steps of Krulik and Rudnick	Test Analysis Results	
		Problem 1	**Problem 2**
1.	Read and Think	The subject needs to explain what is known and what is being asked of the question.	The subject writes down what is known and what is asked in the question.
2.	Explore and Plan	Subjects can organize information obtained from questions, such as explaining how to find FPB	Students sketch the problem to clarify the picture of the problem to be solved and make connections between the information.
3.	Select and Strategy	Subjects use work steps that begin with finding FBP to solve problems	Subjects used several strategies: making with pictures, guessing, testing, and thinking logically.
4.	Find an Answer	The subject performs calculations through pre-determined strategies and steps	The subject performs according to the steps that have been planned through a logical thinking strategy. He uses the information in the problem and can solve the problem by compiling, measuring, and calculating according to the information obtained. Students identify the properties of a square, then think of a number for the value of its sides and choose a number that produces the product of the area of the square.
5.	Reflect and Extend	The subject re-examines the answers and draws conclusions	students recheck the written statements, calculation formulas, and final answers.

This finding is supported by the text of the interview conducted by the researcher with the following SH subject:

Researcher : *What do you know from question number 2?*
SH : *A square garden with an area of 64 m2 and every 1 meter is installed with wire support poles.*
Researcher : *Then what are you asking?*
SH : *how many poles are needed to fence Pak Karto's garden.*
Researcher : *From that matter, did you make a drawing?*
SH : *Yes, bro*
Researcher : *How do you draw it?*
SH : *I made a picture of a square, ma'am. 8 m is the side, ma'am, because the area is 64.*
Researcher : *Did you write down the strategy before solving the problem?*
SH : *just formula*
Researcher : *What formula to use?*
SH : *The formula for the area of a square only*
Researcher : *Tell me how you solve this problem until you get an answer*
SH : *In the problem, there is a square with an area of 64m2. 64 is obtained because a square means that the equilateral sides are equal. 64 is equal to 8x8. I assume the distance between one pole and another pole is 1 meter. Make the first, second, and third pillars until they are 8m long. There are seven pillars. So on one side, there are seven support poles because there are four sides, 7x4 = 28 poles, bro.*
Researcher : *Did you double-check the*

answers before they were submitted?

SH : *Yes, bro*

2. **Subjects with Medium Emotional Intelligence**

MD Subject

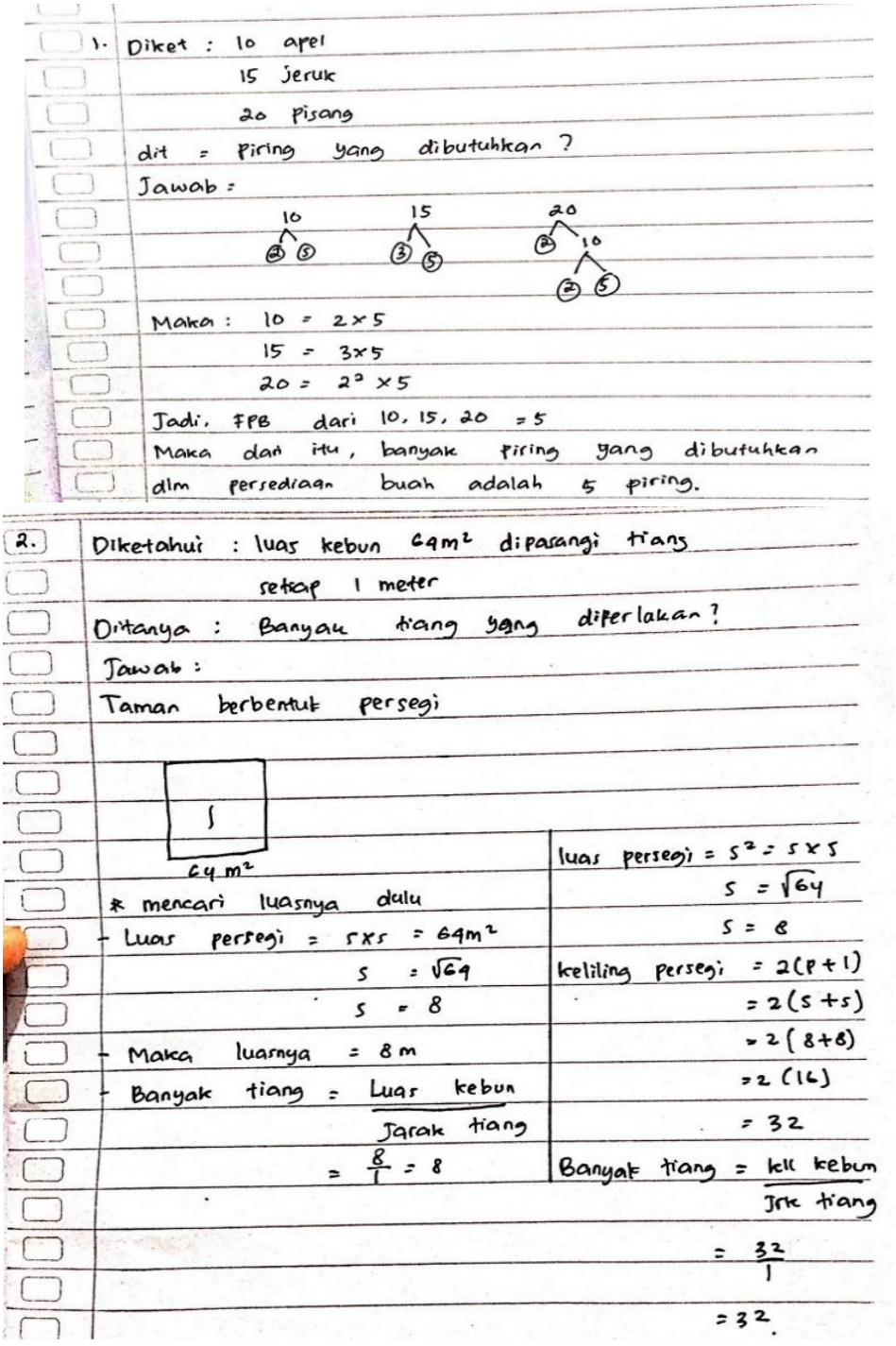

Figure 2. Results of problem-solving MD subjects

Figure 2. Result of MD Work on Questions Number 1 and 2. The student test analysis results are presented in Table 5.

Table 5.
Questions analysis results in numbers 1 and 2 for MD subjects

No	Steps of Krulik and Rudnick	Test Analysis Results	
		Problem 1	**Problem 2**
1.	Read and Think	The subject writes down what is known and what is asked in the question	The subject writes down what is known and what is asked in the question
2.	Explore and Plan	Subjects can relate the information obtained from the questions	Students only sketch a square because the problem does not emphasize the properties of a square but only the size, namely the area of the square. The subject finds the relationship between information.
3.	Select and Strategy	The subject writes down the ideas in his mind by using steps to find the GCF to solve the problem.	Subjects used several strategies: making with pictures, writing equations or open sentences, and making regular lists.
4.	Find an Answer	The subject performs calculations by finding the GCF one by one from 10, 15 and 20	The subject can understand the size of a shape, and he can measure an object well even though it is not visible. Students make plans to solve problems clearly and regularly. They use the information in the problems and solve them by compiling, measuring, and calculating according to the information obtained. However, determining the answer is wrong because the subject needs to think logically about counting many supports.
5.	Reflect and Extend	The subject re-examines the answers and draws conclusions	students check the calculations at each step that has been done. Students also reveal another way, namely, using the formula for circumference.

This finding is supported by the text of the results of interviews conducted by researchers with the following MD subjects:

Researcher : *What do you know from question number 2?*
MD : *64 m^2 garden area with poles installed every 1 meter.*
Researcher : *Then what are you asking?*
MD : *many poles needed.*
Researcher : *From that matter, did you make a drawing?*
MD : *Yes, bro*
Researcher : *How do you draw it?*
MD : *I just drew a square whose area is 64.*
Researcher : *Did you write down the strategy before solving the problem?*
Researcher : *Tell me how you solve this problem until you get an answer.*
MD : *I first look for the area, then I will get the sides, and then I count the number of pillars. The method is to divide the garden area by 1 meter, so eight divided by 1 equals 8. After that, I calculate the garden's perimeter using the formula for the perimeter of a square. The result is 32. Because the question of how many poles to surround the garden so, 32 divided by 1 meter because the distance was 1 meter, the result is 32 .*
Researcher : *Did you double-check the answers before they were submitted?*
MD: *Yes, bro*

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GA subject

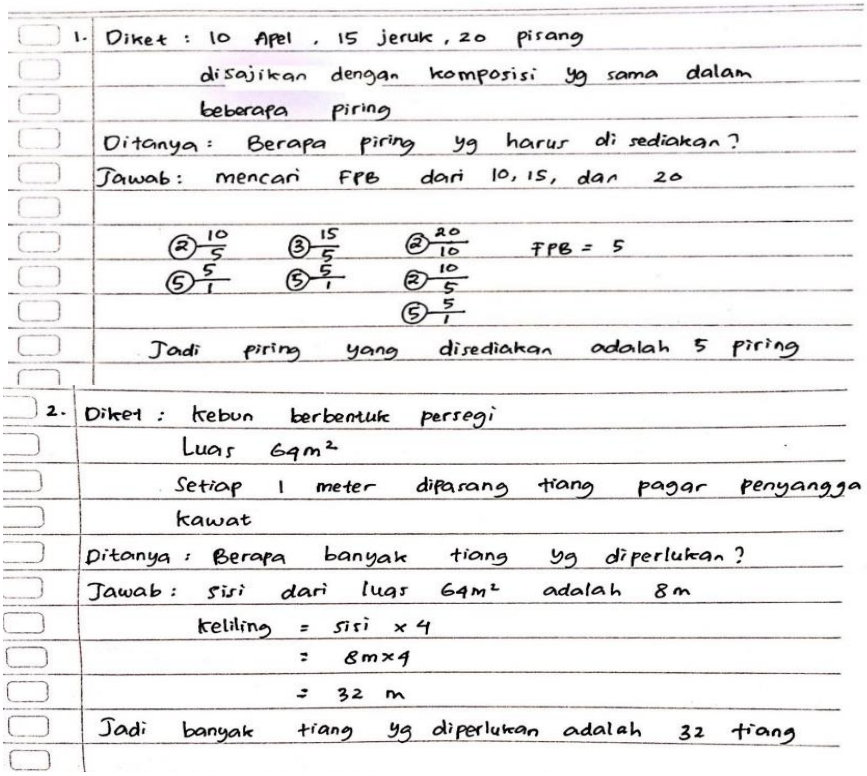

Figure 3. Results of problem-solving GA subjects

Figure 3 is the result of the work of the GA subject on questions number 1 and 2. The results of the student test analysis are presented in Table 6 below:

Table 6.
Questions analysis results in numbers 1 and 2 for GA subjects

No	Steps of Krulik and Rudnick	Test Analysis Results	
		Problem 1	**Problem 2**
1.	Read and Think	The subject writes down what is known and what is asked in the question	The subject writes down what is known and what is asked in the question
2.	Explore and Plan	The subject can relate the information obtained from the question	Students do not draw sketches. The subject relates the information provided
3.	Select and Strategy	The subject writes down the steps by looking for the GCF to solve the problem.	The subject uses a guessing test strategy, students identify the properties of the square and then determine the maximum circumference, but the answer needs to be corrected.
4.	Find an Answer	The subject performs calculations by finding the GCF of 10, 15 and 20	Students choose the correct notation and the right formula, but the reasoning or conclusion is wrong until the wrong solution is obtained
5.	Reflect and Extend	The subject did not double-check the answer, but the conclusion was correct.	The subject did not cross-check the answers and also identified the answers he had written because he was already sure of the answers he got

3. **Subjects with Low Emotional Intelligence**

BA Subject

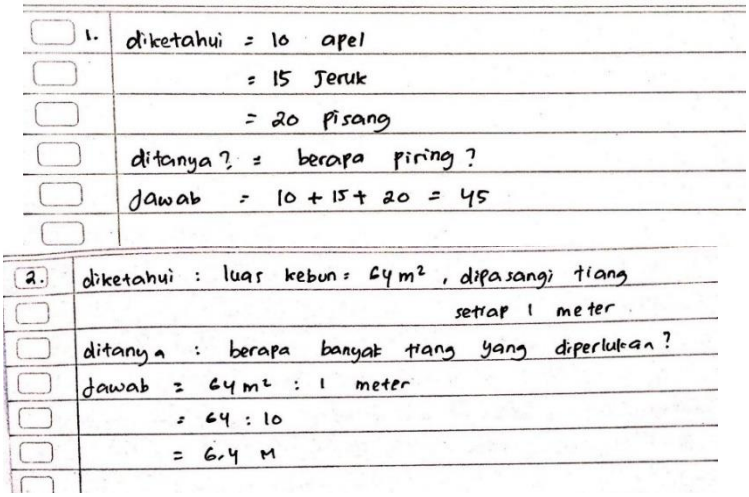

Figure 4. Results of problem-solving BA. subjects

Figure 4 is the result of the BA subject's work on questions number 1 and 2. The results of the student test analysis are presented in Table 7 below:

Table 7.
Questions analysis results in numbers 1 and 2 for BA subjects

No	Steps of Krulik and Rudnick	Test Analysis Results	
		Problem 1	Problem 2
1.	*Read and Think*	The subject writes down what is known and what is asked in the question	The subject can write down what is known and asked in the question
2.	*Explore and Plan*	The subject does not write down the steps in solving the problem	Subjects do not sketch first, and students do not make connections between information
3.	*Select and Strategy*	The subject uses a solution by adding up all the numbers	The subject uses a logical thinking strategy and only guesses the calculation but is wrong
4.	*Find an Answer*	The subject does the calculation, but it still needs to be corrected	that students directly calculate the garden area divided by the distance of the poles. So there is no use of formulas and wrong answers
5.	*Reflect and Extend*	The subject does not write a conclusion	students do not recheck the questions and answers because the subject feels confident with the answer

Researcher : *What do you know from question number 2?*
BA : *The garden area is 64m^2, fitted with a 1-meter pole.*
Researcher : *Then what are you asking?*
BA : *How many poles do you need?*
Researcher : *From that matter, did you make a drawing?*
BA : *No, sis*
Researcher : *Did you write down the strategy before solving the problem?*
BA : *No, sis, I just counted*
Researcher : *Is there a formula you use?*
BA : *Just share*
Researcher : *Tell me how you solve this problem until you get an answer.*
BA : *I divide 64m2 by 1 meter. I changed 1 meter to 10, so 64 divided by 10 equals 6.4 meters.*
Researcher : *Where did you get those ten from?*
BA : *Do not know, sis.*
Researcher : *Did you double-check the*

answers before they were submitted? BA : *No. I will collect it right away.*

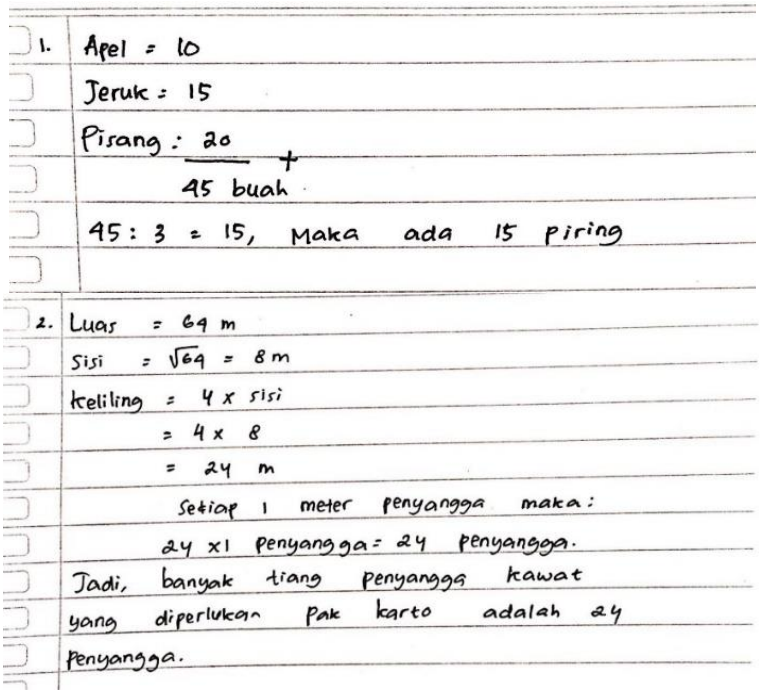

Figure 5. Results of problem-solving DP subjects

Figure 5 is the result of the DP subject's work on questions number 1 and 2. The results of the student test analysis are presented in Table 8 below:

Table 8.
Questions analysis results in numbers 1 and 2 for DP subjects

No	Steps of Krulik and Rudnick	Test Analysis Results	
		Problem 1	**Problem 2**
1.	*Read and Think*	The subject does not write down what is known and what is asked	The subject does not write down what is known and asked in the question
2.	*Explore and Plan*	The subject does not write down the steps in solving the problem	The subject can relate information such as calculating the sides and perimeter of a square
3.	*Select and Strategy*	Subjects use the concept of addition and division. The subject just guessed without testing the answer.	The subject uses the strategy of guessing the calculation without testing it.
4.	*Find an Answer*	The subject does the calculation, but the answer is still wrong	Students perform calculations using the formula for the area and perimeter of a square, but the calculation results need to be corrected.
5.	*Reflect and Extend*	The subject does not recheck the results but writes the wrong conclusion	students do not recheck the questions and answers, which results in wrong answers

Based on the research results, each category of students' emotional intelligence has different problem-solving abilities. Subjects with high emotional intelligence can understand the context of the problem and write information on the question but only on question number 2. Subjects can make representations through sketches to clarify problems and link

information. The subject uses the proper steps or strategies, and the calculations are carried out correctly so that the conclusion is relevant. Based on the interview, the subject always rechecks the answers before they are collected.

Chasanah (2018) stated that subjects with high emotional intelligence could repeat questions using their language, write down what is known and asked, relate information, make plans to solve problems, and the correct answers have been rechecked. Izah (2018) stated that subjects with high emotional intelligence can relate to what they know and are asked similar questions, remember whether they have encountered similar questions, and can mention problem-solving.

Subjects with medium emotional intelligence, both subjects have different problem-solving abilities. The first and second subjects rewrote the information on the problem using their mathematical model and language. The first subject made a picture representation and an orderly plan and steps, while the second did not make a sketch. The two subjects linked the information, but not all students' answers were correct. Based on the interview, subject 1 re-examined the answers obtained. While subject two does not.

This is in line with (Izah, 2018), who explains that students with medium levels of emotional intelligence can understand problems, determine plans solve them, need to be more careful in counting to get answers to questions given, and can conclude reasonably. (Kurniawan, 2017) states that subjects with average emotional intelligence can plan solutions that will be used to solve problems.

Subjects with low emotional intelligence, subject 1, could write down what was known and what was asked in the question. However, subject two still needs to write down information. Subjects made no representations and did not appear to use clear problem-solving steps or strategies. Subjects generally need help to relate information, so they do wrong calculations and only guess the answer. The subjects did not recheck the answers in the interview because they felt confident.

This is in line with the research of (Wahyuni et al., 2018), which states that students who have low levels of emotional intelligence have not been able to understand the context of the problem well, can determine plans to solve problems, and are less careful in counting to get answers to the questions given and have not been able to conclude correctly. (Izah, 2018) explained that the subject students with low emotional intelligence could not explain the solution in their language and could not write the conclusion of the problem correctly.

IV. Conclusion

The results and discussions described conclude that the subject of problem-solving abilities with high emotional intelligence can understand the context of the problem and represent the problem with pictures. Students can link between information, use appropriate strategies or steps, and relevant answers and conclusions. The subject of problem-solving abilities with medium emotional intelligence is rewriting information on the problem using mathematical models and their language. Subjects can relate information, but not all students' answers are correct. Subjects with problem-solving abilities with low emotional intelligence do not make representations and do not use clear problem-solving strategies. Subjects cannot relate information, so they do wrong calculations and only guess the answer.

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